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THE EFFECT OF A PRICE ADJUSTMENT SYSTEM ON THE QUALITY OF EMULSIFIED AND LIQUID ASPHALTS

MATERIALS INFORMATION

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THE EFFECT OF A PRICE ADJUSTMENT SYSTEM ON THE QUALITY OF EMULSIFIED AND LIQUID ASPHALTS

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ABSTRACT

Prior to 1989, the Ministry of Transportation of Ontario, supplied bituminous spraying materials (both liquid asphalts and emulsified asphalts) on all contracts. The Ministry had previously attempted to divest itself of this arrangement but the contractors were reluctant to accept the responsibility for the supply. One of their major concerns was that the quality of the materials was generally poor and historically a large number of samples failed the specified tests.

The Ministry therefore agreed to address the product quality problem prior to any introduction of contractor supply and in 1985 introduced a price adjustment system based on test results. This paper presents background to the development of the system, an outline of the procedure and the effect the system has had on material quality.

It is concluded that the end-result price adjustment system has significantly improved the overall quality of spraying materials supplied to the Ministry. The contractor has been required to supply spraying materials on all Ministry contracts since June 1989.

RÉSUMÉ

Avant 1989, le ministère des Transports de l'Ontario fournissait les matières bitumineuses à vaporiser (le bitume fluide et le bitume émulsifié) pour tous ses contrats. Le ministère a tenté de se décharger de cette responsabilité mais les entrepreneurs étaient peu disposés à se charger de l'approvisionnement; une de leurs grandes préoccupations étant la faible qualité des matières et le fait que, par le passé, de nombreux échantillons avaient échoué les tests requis.

Le ministère a donc accepté de se pencher sur le problème de la qualité des matières avant que les entrepreneurs n'assurent l'approvisionnement et, en 1985, il a mis sur pied un système d'ajustement des prix fondé sur les résultats des tests. Cet article présente une description de la mise sur pied du système de même qu'un aperçu de procédures du système et de ses effets sur la qualité des matières.

On y conclut que le système d'ajustement des prix a permis d'améliorer considérablement la qualité générale des matières bitumineuses à vaporiser fournies au ministère. Depuis le mois de juin 1989, les entrepreneurs sont tenus de fournir les matières bitumineuses à vaporiser pour tous les contrats du ministère

INTRODUCTION

Prior to 1983 the Ministry of Transportation, Ontario did not have a formal acceptance procedure for emulsified and liquid asphalts. Delinquent suppliers were required to give reasons for the problems with their products and explain what precautions they would be taking to justify their continued inclusion on the Ministry's Designated Sources List. This process was not an effective way of ensuring that material complying with specification requirements was consistently supplied.

In 1983 pre-shipment sampling was introduced. The lowest and the second lowest bidders were required to submit samples to the Ministry for approval prior to the award of the supply contract. In three instances the supply was awarded to the second lowest bidder because the low bidder's samples failed to meet specification requirements.

In 1984 the pre-shipment sampling continued and in all cases the supply was awarded to the lowest bidder. An additional system was introduced whereby an excessive failure rate would trigger removal of the supplier from the Designated Sources List. This failure rate was not exceeded and no supplier was removed from the Designated Sources List.

The following table of test results on field samples taken from Ministry capital projects demonstrates the problems with material quality prior to 1985.

TEST RESULTS ON FIELD SAMPLES OF EMULSIFIED ASPHALTS

YEAR	NUMBER OF SAMPLES TESTED	NUMBER OF SAMPLES OFF SPECIFICATION	% SAMPLES OFF SPECIFICATION
1977	191	108	56%
1978	190	98	52%
1979	158	110	69%
1980	165	95	58%
1981		NOT READILY AVAILABLE	
1982	148	102	67%
1983	134	80	60%
1984	234	73	27%

NOTE: A sample was deemed off-specification when one or more of the requirements was outside of the specification limits. These requirements are detailed in **SUMMARY OF THE ACCEPTANCE SYSTEM - Payment** below.

It is noticeable in 1984, following the introduction of the pre-shipment verification testing scheme in 1983, that the number of off-specification samples reduced dramatically.

CONTRACTOR SUPPLY

In January 1984 the contracting industry and suppliers of spraying materials in Ontario were informed by the Ministry that two major changes were to be made to the supply arrangements for emulsified asphalts and liquid asphalts. These were:

1. The contractor would be required to supply all emulsions and liquid asphalts on Ministry contracts.
2. The emulsions and liquid asphalts delivered and used would be subject to price reductions when outside specification limits.

- **The Ministry Perspective**

There were two principle reasons why contractor supply was considered to be in the best interests of the Ministry:

1. With the Ministry supplying the emulsified and liquid asphalt, the responsibility for the quality of the work was divided between the contractor, the supplier and the Ministry and this led to frequent problems when the quality of the work was sub-standard. For example, several instances were reported where rain followed the placement of a surface treatment, and the treatment subsequently failed. Laboratory testing then revealed that the quality of the asphalt emulsion was not to specification but it was impossible to proportion responsibility for the poor quality of the finished product between bad construction practice and poor material quality. The contractor would argue that the work would not have failed if the material had met specification. The Ministry was therefore obliged to accept sub-standard work. This confusion could have been avoided if the contractor was responsible for the entire package. It would then be his risk if he decided to work when rain was forecast and the responsibility for the quality of the finished product would be clearly defined.

2. The other area of concern was demurrage payments and again this was complicated by having three parties responsible for the work. Demurrage was payable to the transporter of the materials if the transport vehicles were not unloaded within the time allowed in the contract. Such payments were made by the Ministry if it was responsible for delaying the work; for example, by initiating design changes. The contractor would be liable for the demurrage payments if he was responsible for the delay; for example if his equipment had broken down or if he had ordered too much material. Delays due to poor weather conditions were at the contractor's risk. Again these payments became very difficult to determine if the circumstances were complex.

   Demurrage payments made to the supplier or to the supplier's transportation company were invariably invoiced much later than the invoices for the payment for the material itself. This created a major records problem for the site staff and required them to reassess the entire job after everything else had been finalized.

- **The Industry Perspective**

It was expected that the industry would be divided about this issue. Approximately 50 per cent of the suppliers of emulsified and liquid asphalts also had their own spraying capability while the other 50 per cent of the suppliers did not. Those companies with the capability to provide the complete package would probably favour the new system while the independents would favour the existing arrangements. The Ministry purchased some 20 per cent of the emulsified and liquid asphalts sold in the Province in 1983.

The responses from the industry to the proposed changes were negative. The contractors made the following comments:

1. The contractors said it would be irrational for them to accept this supply specification without having some control over the quality of the product.
2. It would limit competition by providing vertically integrated companies, with both contracting and supply capabilities, an unfair advantage.
3. Price escalation could result.
4. The Ministry was trying to shift the responsibility for off-specification material to the contractors.

Likewise the suppliers responded negatively to the changes as follows:

1. The quality of the Ministry's testing is questionable.
2. The suppliers have no control over the material once it leaves their facilities since the contractor designates the carrier.
3. The proposed price reduction penalties are generally too severe.
4. The suppliers can foresee endless litigation resulting from the introduction of the new requirements with the supplier being an unpaid third party stuck in the middle.

The opposition presented by the contracting and supply industries finally led to a reassessment of the Ministry's position. The introduction of the price adjustment system and the contractor supply requirements were deferred. The approval process for the lowest bidder and second lowest bidder was retained with the additional condition that suppliers who supply off-specification material would not be allowed to supply that product from the same plant on further Ministry work in 1984, i.e. outstanding orders would be cancelled. The Ministry also required that responsibility for the haulage of all product from the plant to the job site would be the responsibility of the suppliers.

TESTING

In view of the concerns raised by the suppliers over the quality of the Ministry's testing, a number of correlation programs have been set up in order to ensure that the testing is carried out to a high standard. An intra-provincial correlation program, which includes seven suppliers' laboratories as well as the three Ministry laboratories, is carried out every month during the construction season. Each laboratory is required to test two samples of HF-150S emulsified asphalt. The results of the testing are analyzed in the Ministry's Head Office.

The Ministry's laboratories also partake in the Canadian Asphalt Exchange correlation program for emulsified asphalt and liquid asphalt and the AASHTO program for liquid asphalts only.

These exercises have enabled the Ministry and industry to monitor the quality of the testing and has given the industry confidence in the Ministry's test results.

END-RESULT SPECIFICATION

The Ministry realised that, until the quality of the products could be improved any change in the supply arrangements would be met with strong resistance by the contracting industry. The doubts raised over the quality of the Ministry's testing would also have to be addressed. The Ministry therefore agreed to tackle the product quality problem prior to any introduction of a contractor supply procedure. To this end, an End-Result Acceptance System was introduced.

- Components of the System

The general goals of any End-Result Specification, as perceived by the Ministry of Transportation Ontario, are: separation of responsibilities for process control and for acceptance; recognition of inherent variability in materials and testing; allowances for the acceptance of material that does not quite meet contractual requirements; and provision for re-testing of failed material.

- Separation of Responsibilities

Prior to the introduction of the End-Result Acceptance System the Ministry carried out acceptance testing of the products supplied to their contracts but the turn-round time of the test results was not sufficiently fast for the supplier to use results to control his manufacturing process. With the introduction of an End-Result Acceptance System, the results of the

Ministry's testing would not be produced any more quickly than before. The prudent supplier would therefore carry out his own process control testing, the results of which could be produced more quickly, before the material is shipped to the job site. It is not known how much process control testing was carried out by the suppliers prior to the introduction of the End-Result Acceptance System, but it is believed that most of them now have comprehensive laboratory facilities.

- **Recognition of Variability**

Variability is always present in materials, in sampling and in testing. To accommodate this variability, the specification must recognize its existence so that whatever is specified can be produced by a supplier exercising reasonable process control.

- **Acceptance of Borderline Materials**

The acceptance system recognizes that, even though a material does not meet contractual requirements it still has value, especially when test results show that the material is only marginally outside the requirement limits.

- **Retesting**

The Ministry recognizes that no testing procedure is infallible and mistakes can be made. Allowances are made in the system for re-testing when unacceptable results are obtained. It is usual, when results are challenged and a new set of values obtained, for the challenged values and the retest values to be combined and used for acceptance. However, in the case of spraying materials, the test value which is most favourable to the contractor is used.

SUMMARY OF THE ACCEPTANCE SYSTEM

The acceptance system used by the Ministry has undergone minor modifications since it was first introduced in 1985. For example, payment reductions for non-compliance with the sample delivery requirements was not included in the original system. The system described is the one currently used on Ministry contracts.

- **Sampling**

The contractor is responsible for all sampling, labelling and delivery of the samples to the location indicated in the contract. The sample, consisting of a minimum of one, 1 L container of material for liquid asphalts and two, 4 L containers for emulsified asphalts and emulsified asphalt primers, is taken from each shipment of material. Each tanker load (or tanker plus trailer) is considered as a lot of material. The samples are taken only after at least 4000 kg has been drawn from the tanker. Sample containers are provided by the contractor.

- **Sample Delivery**

The contractor or the contractor's representative is required to deliver the sample to a designated location within 5 business days of sampling and it must remain in a condition suitable for testing for at least 14 calendar days after sampling. The contractor has to comply with all current documentation appropriate to the shipping and handling of the samples, e.g. Material Safety Data Sheets and Dangerous Goods.

Price reductions are applied when the samples are not delivered to the Ministry's designated location in good condition and in a timely fashion. A penalty of 10% is applied if:

(i) A sample is not received for testing.

(ii) The sample is not of the correct size; i.e. there is not sufficient material to carry out all specified tests.

(iii) The sample does not remain in a condition which is suitable for testing for 14 calendar days after sampling or until tested, whichever is sooner.

(iv) The sample is not delivered within 5 business days of sampling and the sample does not remain in a condition which is suitable for testing until the Ministry is able to test the sample.

On receipt at the laboratory, all sample containers are immediately weighed and their weights recorded. When the sample consists of two pails of material, the heaviest pail is tested first. The second, lighter pail can be used to obtain additional material at any time provided that the first pail is exhausted.

Samples are required to be delivered to one of the three Ministry laboratories equipped to carry out testing on some or all of these materials.

- **Testing**

The first test on a sample of emulsified material must be commenced within 14 calendar days of sampling. If the delivery requirements have been complied with but the testing is not commenced within 14 calendar days, no price adjustment will be made regardless of the results of any tests carried out later on the sample and payment will be at the full contract price.

When tests show that a liquid asphalt, emulsified asphalt or emulsified asphalt primer sample complies with the material quality requirements of the contract, immediate notification of the test result is not required; a copy of the Laboratory Inspection Report is mailed to the contractor.

When a liquid asphalt, emulsified asphalt or emulsified asphalt primer sample is delivered in a condition which is suitable for testing and tests show that the binder has not conformed with the material quality requirements, then a price adjustment will be derived through the use of a system of adjustment points. The contractor is immediately informed of the test results by phone or fax.

- **Retesting**

If any test(s) of a liquid asphalt sample does not meet the material quality requirements then the test(s) is automatically repeated in the laboratory where the original testing was carried out. If there is insufficient material to perform the repeat testing then the original test result(s) stand.

If any test(s) of emulsified asphalt or emulsified asphalt primer does not meet the material quality requirements then the test(s) is automatically repeated in the laboratory where the original testing was carried out. If there is insufficient material to perform the repeat testing in the original pail then material from the second pail may be used to make up the required quantity. The second pail must be immediately resealed after extracting the additional material. If there is insufficient material to perform the repeat testing then the original test result(s) stand.

If tests of emulsified asphalt or emulsified asphalt primer, performed in Regional laboratories, do not meet the material requirements for viscosity (Saybolt Furol Seconds), residue by distillation or penetration on residue tests, then the contractor has the option of having the second pail of material tested in the Ministry's Head Office laboratory. The contractor must request, in writing, that he requires the retesting to be carried out, the request must be specific to the results of tests carried out on one sample. "Blanket" requests to have all samples which fail these tests retested in the Head Office laboratory are not acceptable. The contractor is responsible for arranging shipping and the cost of the shipping of the remainder of the sample to the Ministry's Head Office.

If retesting of the failed test(s) cannot be completed while the sample is still in a suitable condition for testing then the original test results will apply for the tests which could not be repeated.

- **Payment**

Payment for lots of binder which meet the contract requirements are made at the full contract price. Payment for lots which do not meet all material requirements are subjected to a price adjustment; that is, a reduction in the contract price for the item, expressed as a percentage of the contract price. Each test has a multiplying factor applied to the number of units by which the test deviates from the specification requirements. These multipliers were set subjectively, based on the perceived importance of each test to the performance of the product on the road. Some minor adjustments were made to the multipliers following a simulation of the impact of introducing the system. Soon after the system was introduced the multiplier values were challenged on one occasion but have now been fully accepted by the contracting industry.

As stated in **Sample Delivery** above, a 10 % price adjustment will be applied to a lot when the sample delivery requirements have not been satisfied.

- **Emulsified Asphalt Binder**

When an emulsified asphalt binder has been delivered in the prescribed manner, has remained in a condition suitable for testing and the test results show that the binder has not conformed with the material requirements, then a price adjustment is derived through the use of a system of adjustment points as follows:

Adjustment Points for Emulsified Asphalt Binders

The total number of adjustment points is equal to the summation of the number of units that each test deviates from the specification limits times the multiplier, plus

1000 adjustment points for failure of the Particle Charge Test,
1000 adjustment points for failure of the Fire Resistance Test, and
200 adjustment points for failure of the Coating Test when the binder type is HF-100S, HF-150S, or HF-250S.

The Particle Charge Test, the Fire Resistance Test and the Coating Test for HF-100S, HF-150S and HF-250S have a pass/fail criteria.

Prior to the summation, all adjustment points are rounded to one decimal place in conformance with ASTM Designation: E 29-67 (Approved 1980).

Table of Tests, Units and Multipliers for Emulsified Asphalt Binder Types RS-2, CRS-2, HF-100S, HF-150S, and HF-250S

Test	Unit	Multiplier
Residue by Distillation	%	200
Viscosity (less than minimum)	SFS	30
Viscosity (greater than maximum)	SFS	5
Demulsibility %	50	
Penetration at 25 °C	0.1 mm	15
Settlement %	30	
Storage Stability	%	50
Coating Test (for MS and SS anionic and cationic, and mixing grade high float emulsions)	%	20
Oil Portion of Distillate, by vol. of emulsion	%	50
Sieve Test %	1000	
Apparent Viscosity at 60 °C	Pa.s	10**
Float Test at 60 °C	s	2
Solubility in Trichloroethylene	%	10
Ductility at 25 °C	cm	10
Cement Mixing	%	100

Note: ** This multiplier is used when the apparent viscosity plots below AB or AB extrapolated, CD or CD extrapolated, EF or EF extrapolated on Figure 1 of OPSS 1103, October 1989.

Where more than one test result is available the test result with the least deviation from the specification limit will be used to calculate the price adjustment.

The total number of adjustment points for each sample is divided by 100 to obtain the price adjustment percentage per lot. When the price adjustment for a lot of binder would exceed 25.0 %, no payment is made for that lot (tanker load) of binder.

- **Polymer Modified Emulsified Asphalt Binder**

When a polymer modified emulsified asphalt binder has been delivered in the prescribed manner, has remained in a condition suitable for testing and the test results show that the binder has not conformed with with the material requirements, then a price adjustment is derived through the use of a system of adjustment points as follows:

Adjustment Points for Polymer Modified Emulsified Asphalt Binders

The total number of adjustment points is equal to the summation of the number of units that each test deviates from the specification limits times the multiplier, plus

1000 adjustment points for failure of the Particle Charge Test

The Particle Charge Test has a pass/fail criteria.

Prior to the summation, all adjustment points are rounded to one decimal place in conformance with ASTM Designation: E 29-67 (Approved 1980).

Table of Tests, Units and Multipliers for Polymer Modified Emulsified Asphalt Binder Types RS-2(P), CRS-2(P), HF-100S(P), and HF-150S(P)

Test	Unit	Multiplier
Residue by Distillation	%	200
Viscosity (less than minimum)	SFS	30
Viscosity (greater than maximum)	SFS	5
Demulsibility %	50	
Penetration at 25 °C	0.1 mm	15
Settlement %	30	
Storage Stability	%	50
Oil Portion of Distillate, % by vol. of emulsion	%	50
Sieve Test	%	1000
Float Test at 60 °C	s	2
Solubility in Trichloroethylene (1)	%	10
Ash Content, % by Mass of Residue (1)	%	1000
Elastic Recovery at 10 °C	%	30
Force Ductility at 800% Elongation, 5 cm/minute Pull Rate, at 4 °C	kg	1000

Notes The ash content shall be determined when the manufacturer indicates that the polymer additive is not soluble in trichloroethylene.

Where more than one test result is available the test result with the least deviation from the specification limit is used to calculate the price adjustment.

The total number of adjustment points for each sample is divided by 100 to obtain the price adjustment percentage per lot. When the price adjustment for a lot of binder would exceed 25.0 %, no payment is made for that lot (tanker load) of binder.

- **Liquid Asphalt Binders and Primers**

When a liquid asphalt binder has been delivered in the prescribed manner and tests show that the binder has not conformed with the material requirements, the price adjustment is calculated as follows:

Adjustment Points for Liquid Asphalt Binders and Primers

The total number of adjustment points will be equal to the summation of the number of units that each test deviates from the specification limits times the multiplier.

Prior to the summation, all adjustment points will be rounded to one decimal place in conformance with ASTM Designation: E 29-67 (Approved 1980).

Table of Tests, Units and Multipliers for Liquid Asphalt Binders and Primers

Test	Unit	Multiplier
Residue from Distillation to 360 °C	%	200
Kinematic Viscosity at 60 °C	mm^2/s	20
Flash Point °C	100	
Distillate (% of total distillate to 360 °C)		
to 190 °C	%	10
to 225 °C	%	10
to 260 °C	%	10
to 316 °C	%	10
Penetration at 25 °C	0.1 mm	15
Ductility at 25 °C	cm	10
Softening Point	°C	10
Solubility	%	10
Residue Kinematic Viscosity at 60 °C	mm^2/s	20
Residue of 100 Penetration	%	5
Ductility of 100 Penetration Residue at 25 °C	cm	5

Where more than one test result is available the test result with the least deviation from the specification limit is used to calculate the price adjustment.

The total number of adjustment points for each sample is divided by 100 to obtain the price adjustment percentage per lot. When the price adjustment for a lot of binder would exceed 25.0 %, no payment is made for that lot (tanker load) of binder.

- **Emulsified Asphalt Primer**

When an emulsified asphalt primer has been delivered in the prescribed manner, has remained in a condition suitable for testing and the test results show that the binder has not conformed with the material requirements, then a price adjustment is derived through the use of a system of adjustment points as follows:

Adjustment Points for Emulsified Asphalt Primers

The total number of adjustment points is equal to the summation of the number of units that each test deviates from the specification limits times the multiplier, plus:

1000 adjustment points for failure of the Settlement Test, 5 days.

The Settlement Test has a pass/fail criteria.

Prior to the summation, all adjustment points are rounded to one decimal place in conformance with ASTM Designation: E 29-67 (Approved 1980).

Table of Tests, Units and Multipliers for Emulsified Asphalt Primers

Test	Unit	Multiplier
Residue by Distillation	%	200
Viscosity at 50°C (less than minimum)	SFS	30
Viscosity at 50°C (greater than maximum)	SFS	5
Oil Portion of Distillate, by volume EA Primer	%	50
Penetration at 25°C	0.1 mm	15
Flash Point (Open Tag)	°C	10
Ductility at 25°C cm	10	
Solubility	%	10

Where more than one test result is available the test result with the least deviation from the specification limit will be used to calculate the price adjustment.

The total number of adjustment points for each sample is divided by 100 to obtain the price adjustment percentage per lot. When the price adjustment for a lot of binder would exceed 25.0 %, no payment is made for that lot (tanker load) of binder.

IMPLEMENTATION

1985 saw only a limited application of the system with more material being subject to adjustment in 1986. Penalties amounting to 3.4 per cent of the dollar value were applied during 1986 due to poor quality material. In 1987 and 1988 the system was fully applied to all material and the quality improved to the extent that less than 0.5 % of the dollar value was retained due to non-compliance of material quality. This represented $15,686 and $13,995 for the 2 years respectively. A summary of the payment adjustments since the introduction of the payment reduction system is as follows:

QUALITY OF MINISTRY SUPPLIED EMULSIFIED ASPHALTS (2)				
Year	Quantity, t	Total Contract Price $ (1)	Payment, $(1)	Adjustment, %
1985	896.18	323,250.00	321,253.00	0.6
1986	3,729.00	1,281,215.00	1,237,482.00	3.4
1987	11,393.88	3,228,365.94	3,212,679.40	0.49
1988	11,620.25	3,079,753.07	3,065,757.79	0.45

Notes: (1) Includes Ontario Retail Sales Tax.
(2) Includes liquid asphalts and emulsion primers

A review of the '87 and '88 contracts reveals that all of the major suppliers of emulsified and liquid asphalts were affected to some degree; no one supplier was bearing the full burden of the penalties.

CONCLUSION

The introduction of the end-result specification had the desired effect of improving the quality of the materials purchased by the Ministry. As a result, the contractor has been required to supply the materials on all Ministry surface treatment contracts since June 1989. The fears of both contractors and suppliers of assuming risks previously borne by the Ministry were allayed and the administration of the contracts has been clarified and simplified, thus relieving Ministry site staff of much subjective decision making. The clearly defined responsibilities of all parties has led to greater uniformity of interpretation of Ministry contracts across the Province.

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